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ALLEGED METEORITE FROM HORSHAM, VICTORIA.

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Abstract.

A specimen of natural slag collected at Horsham in Victoria, Australia, in 1924, was regarded at the time of its discovery as a meteorite. The nature of this material has now been established and in view of observed meteor phenomena shortly before the discovery of the specimen, it appears that the natural slag resulted from the incineration of vegetable matter and subsequent fusion of its ash with a little admixed mineral matter, under the influence of the heat produced by a burning meteor.

Introduction.

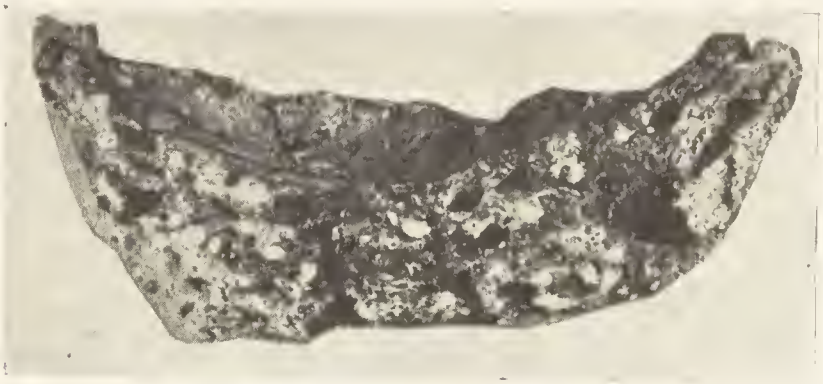
The natural slag from Horsham, was found by a youth on October 15th, 1924, in an area approximately 1 mile west of the township of Horsham in Western Victoria, a day or so after several people in the vicinity had witnessed phenomena attributed to the fall of a meteor. The specimen, alleged to be of meteoritic origin, was received by Mr. W. Reed of St. John's Vicarage, Horsham, who promptly submitted it to the Government Astronomer (Dr. J. M. Baldwin) at the Melbourne Observatory. The specimen was thence despatched for examination and comment to Professor E. W. Skeats at the Melbourne University Geological Department on October 24th, 1924. The author received the specimen in 1950 from Professor E. S. Hills, Geology Department, University of Melbourne, for further examination.

The specimen weighed 92·05 grams as received, and this represents a little over one-half of the complete specimen, which was broken in 1924 before being despatched to the Government Astronomer. The location of the broken-off portion is unknown.

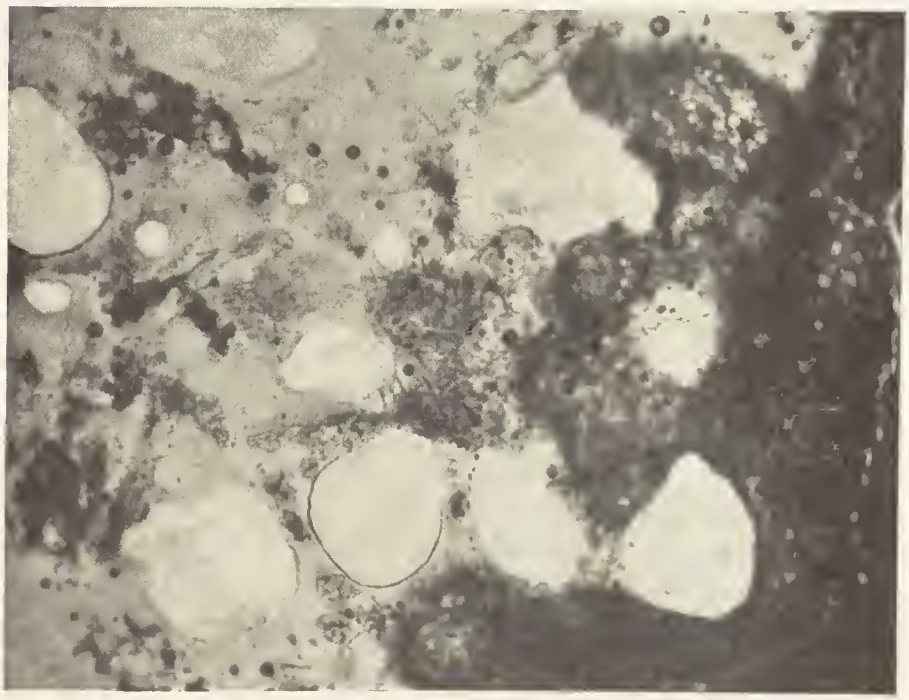
Description of Specimen.

Reconstruction of the shape of the Horsham natural slag specimen from the fragment submitted for investigation, reveals that the original configuration was that of a crudely oval, saucer-shaped object (see photograph 1) measuring approximately 4 ins. by 3 ins. across and $\frac{3}{4}$ to 1 in. in thickness, the centre being $\frac{3}{4}$ in. below the equatorial rim. The concave surface, which was presumably the upper surface, is vitreous and inclined to be ropy, but the convex, presumably under surface, is more sintery in appearance, except in equatorial regions where for $\frac{1}{2}$ in. below the rim, much of the surface is vitreous like the concave surface.

Freshly fractured surfaces of the specimen, broken across radially, reveal the marked vesicular character of its interior. Approximately 25 per cent. of the gas cavities present are lined with a thin crust of a soft, white, chalky substance that is isotropic to cryptocrystalline and is regarded as a residuum from wood ash and fluxes. Remnants of carbonized plant tissue are loosely attached to the walls of some of the larger, elongated cavities.



1. Side view of the Horsham natural slag specimen, showing saucer-shape and vesicular character of the interior. (Natural size.)



2. Thin section of glass showing included plant tissue on right, large and small bubbles in centre and on left. (× 100.)

The glass, which is principally pale bottle green in colour, becomes black in the vicinity of cavities containing partially incinerated plant fibres. Impressions of plant tissue have been preserved as casts in parts of the glass, but wherever still present, the plant tissue has been largely converted to charcoal.

Fragments of the glass immersed in refractive index liquids show smoke-coloured streaks composed of aggregates of minute, rounded, dark brown to black particles representing partially dispersed remnants of carbonized plant tissue. Minute cavities associated with such areas are bubble-like and evidently partly due to gases discharged from the heated plant tissue and eventually trapped in the glass on rapid cooling. Some cavities, however, represent isolated remnants of plant cell structures. The refractive index of the glass varies from 1·530 (colourless) to 1·535 (pale yellowish-green).

Microscope sections (photograph 2) reveal that thin plates of the glass have few flow lines, locally restricted to regions around gas cavities. Rare, partially fused quartz grains are subangular to rounded and contain very rare needles of apatite. These inclusions of apatite, however, are insufficient to account for the P_2O_5 content (see table 1), the bulk of which must lie occult in the glass. Ninety-five per cent. of the Horsham slag consists of vesicular glass, the remainder being mainly plant remnants (charcoal, &c.) and a little quartz. The larger of the gas pores range up to 6·0 by 3·0 mm. across; smaller gas pores are numerous and range from 0·04 mm. to 0·01 mm. (photograph 2).

A polished surface of the glass shows scarce, minute specks of pyrite, none of which exceeds 0·001 mm. in size.

The remnants of plant material in the glass show various phases of destruction and dispersal. In addition to the larger carbonized fragments visible in the hand specimen, there occur in thin section:—

(i) fibrous tissues that are birefringent, but with the cell contents carbonized;

(ii) ghost-like remnants of plant tissue, the cell structures of which are composed of masses of fine, short fibres showing birefringence and straight extinction. These fibres resemble some of the constituents of the white material lining the walls of certain cavities and evidently have their origin in the salts contained in plant tissues;

(iii) occasional isolated three dimensional rosettes and cruciform crystals that are weakly anisotropic and allied to the fibres in the remnant plant-cell structures;

(iv) colourless, isotropic bodies that are frequently concentrated in the glass surrounding the altered plant tissues and anisotropic fibres. They are sub-rounded in outline, average 0·20 mm. across and have a slightly higher refractive index than the enclosing glass. These bodies are evidently lechatelierite particles derived from the silica content of the altered plant tissues, or alternatively have resulted from the fusion of small quartz grains caught up in the original aggregate of vegetable matter. Clusters of small, weakly anisotropic particles attached to some carbonized wood fragments are incompletely fused, siliceous soil particles originally adhering to the vegetable matter;

(v) rare pollen grains and small, reddish-brown resin bodies.

Chemical Analysis.

A chemical analysis of the Horsham natural slag has been carried out in the chemical laboratory of the Mineragraphic Investigations Section, Commonwealth Scientific and Industrial Research Organization, with the following results (Table 1):—

TABLE 1.

	%
SiO_2	60·04
Al_2O_3	1·75
Fe_2O_3	0·18
FeO	0·13
MgO	3·90
CaO	9·28
Na_2O	10·63
K_2O	11·53
H_2O (+)	1·06
H_2O (−)	0·18
CO_2	0·32
TiO_2	tr.
P_2O_5	0·73
MnO	0·47
C	0·08
Cl_2	0·03
SO_3	0·02
Total	100·33

Neither nickel nor chromium was detected in the chemical analysis (Analyst: G. C. Carlos).

The low alumina and high potash and soda contents of the Horsham slag, together with the presence of carbon and significant quantities of MnO, are indications of vegetable source materials. The lime content is comparable with the amounts of lime contained in glasses and slags derived from vegetable matter, as in such products as straw silica glass from O.B. Flat, South Australia, where the lime content is 8·56 per cent. (Fenner, 1940), and slag from charcoal in the suction gas plant, Stawell, Victoria (Baker and Gaskin, 1946, p. 94), where the lime content is 8·21 per cent. The lime content in other natural glasses such as impactites, Darwin Glass, Libyan Glass, australites, &c., is much lower, ranging from nil to 5·25 per cent. (Baker and Gaskin, 1946, p. 94).

Comparison with Other Fused Products of Natural Origin.

The alleged meteorite from Horsham is referred to herein as a natural slag, because it is a completely fused product, formed in the presence of fluxes and hence bears little relationship or resemblance to natural sinter (*cf.* Baker, 1953a) which is a partially fused, clinker-like product devoid of fluxing materials. Such clinker-like masses are usually fused soils of siliceous character, relatively free of vegetable matter, that have evidently been fused by lightning phenomena. The Horsham slag not only differs from such sinters, but also bears no relationships to fulgurites, which are well-known products of lightning fusion. Moreover, the slag is both mineralogically and chemically unlike the clinkers derived from the natural incineration of coal seams, e.g. the naturally fused sub-bituminous coal ash of Leigh Creek, South Australia (Baker, 1953b). Neither is it allied to impactites (due to "meteorite splash"), nor to tektites (extra-terrestrial), and is certainly not of volcanic or of artificial origin. The general appearance of the Horsham specimen, taken in conjunction with its chemical composition, its low specific gravity (2·00—determined in the powdered form at 20° C) and the fact that it commenced to fuse in the laboratory at approximately 650° C, places this natural slag in the same category as a group of products referred to variously as "straw silica glass", "slag from charcoal", &c.

Origin of the Natural Slag.

The source materials of the Horsham natural slag consisted of the ash residue from incinerated plant materials containing a little admixed mineral matter. The source of heat is not definitely

known, and can only be inferred by the elimination of certain heating agents and by taking cognizance of certain observed phenomena recorded in Mr. W. Reed's letter to the Government Astronomer in October, 1924.

Fusion was evidently rapid and due to a source of heat of short duration, followed by rapid cooling. Heating by lightning, bush fires, grass fires, haystack fire, and the like, is ruled out by the fact that no phenomena indicating any of these agencies were recorded at the time of discovery of the specimen. On the other hand, Mr. W. Reed's letter of 21st October, 1924, sets out evidence for the belief that meteoritic phenomena had occurred near Horsham shortly before the specimen was found. The letter states that on October 13th, 1924, " a brilliant meteor fell about a mile to the west of this town (Horsham) and was seen from close (at hand) by at least one man. The flash of light was very brilliant and the detonation like the report of a cannon. The detonation was heard by many people at eight o'clock or a little later. Apparently the object burst before it touched ground, for no trace of its having disturbed the soil can be found. It is a fallow paddock over which it is supposed to have burst. The fragment I am sending you was found a day or so after by a lad living in the vicinity. I have compared it with all products of coal from gas works and elsewhere, but this fragment seems to be *sine generis* ".

The fact that the specimen is particularly fresh in appearance points to its obviously recent age. Its chemical composition shows that it is essentially similar to the " straw silica glass " formed as residue from burning haystacks, where the silica contained in grass fuses with the alkalies, &c., to form a slag-like product. This in itself, however, does not necessarily imply a similar source of heat for the production of the Horsham natural slag, and if the observed phenomena have been correctly interpreted and no grass fire, whether accidentally or purposely generated, had occurred, then it becomes highly probable that an incandescent meteorite, bursting over a fallow paddock and almost burnt-out on landing, could have supplied the heat necessary to incinerate aggregated vegetation and fuse the residual ash and attached soil particles to form a glassy slag. No true meteorite was located and no estimates were given of the height at which the phenomena were observed. No further specimens are known to have been found in the area where the observations were originally made.

Acknowledgments.

The author is indebted to Professor E. S. Hills of the University of Melbourne, for making available the Horsham alleged meteorite and the accompanying explanatory letter from Mr. W. Reed. Thanks are due also to J. McAndrew, Ph.D., for the photograph of the specimen, and to E. Matthaei, Dip.Opt., for the photograph of the thin section.

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